

THE SCIENCE AND TECHNOLOGY OF UXO REMOVAL AND SITE REMEDIATION

SENSOR WORKSHOP REPORT

11 NOVEMBER 1999

SENSOR TECHNOLOGIES

- SENSORS
 - DETECT, CLASSIFY, IDENTIFY
- PROOFING
- NAVIGATION
- PLATFORMS
- INTEGRATION
- DATA LOGGING
- OTHER APPLICATIONS

SENSOR TECHNOLOGIES

- SENSORS
 - DETECTION (UXO OR NOT)
 - EMI
 - TIME DOMAIN, FREQUENCY DOMAIN
 - GPR
 - CHEMICAL
 - BIOLOGICAL, ANALYTICAL TRACE
 - SEISMIC
 - MAGNETOMETER
 - *ELECTRO-OPTIC*
 - UNDERWATER
 - ACOUSTIC, ELECTRO OPTIC, MAGNETOMETER, CHEMICAL

SENSOR TECHNOLOGIES

- SENSORS
 - CLASSIFY (TYPE OF UXO)
 - EMI
 - GPR
 - *MAGNETOMETER*
 - IDENTIFICATION (UXO FEATURES)
 - NEUTRON
 - *ACOUSTIC*
 - *X-RAY*
- PROOFING

SENSOR TECHNOLOGIES

- NAVIGATION
 - COTTON THREAD ODOMETRY
 - ACOUSTIC
 - DGPS
- INTEGRATION
 - SINGLE SENSOR ARRAYS
 - *MULTIPLE SENSORS ARRAYS*

SENSOR TECHNOLOGIES

- PLATFORMS
 - MAN PORTABLE
 - VEHICLE MOUNTED
 - AIRBORNE
- DATA LOGGING
 - SINGLE SENSOR
 - MULTIPLE SENSOR

STRENGTHS/WEAKNESSES

| SENSOR TECHNOLOGY | STRENGTH | WEAKNESS |
|--------------------------|---|--|
| EMI | All metals, mature, inexpensive, robust | False alarm rate, depth limited, operator input |
| GPR | Imaging, exploitable returns | False alarms, soil conditions |
| CHEMICAL | Specific, ID scrap, eliminates areas | Residual dependent, time sensitive, false alarms |
| SEISMIC | Deep, other areas | Resolution, R&D |
| MAGNETOMETER | Penetration, mature | Ferritic soil |
| EO | Surface UXO, airborne | Buried UXO, cost |
| NEUTRON | ID tool, specificity | Regulatory, expense |
| ACOUSTIC ID | ID tool, specificity | Data library |
| ROPE LINES | Accurate, rugged terrain | Wind, anchor point |
| ACOUSTIC NAV | Canopy, accuracy | Range, wind |
| DGPS | Accurate, effective | Canopy, coverage |

STRENGTHS/WEAKNESSES

| SENSOR TECHNOLOGY | STRENGTH | WEAKNESS |
|--------------------------|-----------------------|---------------------|
| HAND HELD | Wide range, cost | Operator, slow |
| TOWED | Productivity, weather | Terrain, impact |
| AIRBORNE | Fast, terrain | Resolution, weather |
| MAG & FLAG | Simple, localization | Record, operator |
| HYBRID | Data, discrimination | Holiday |
| DATA LOGGING | Records, processing | Complicated |

APPLICABILITY

| DEPLOY | DETECT | CLASS | ID | HAND | CART | TOWED | AIR |
|--------------|--------|-------|----|------|------|-------|-----|
| TECHNOLOGY | | | | | | | |
| EMI | H | H | L | H | H | H | L |
| GPR | L | M | L | H | H | H | L |
| CHEMICAL | L | L | H | H | L | L | L |
| SEISMIC | L | M | L | H | L | L | L |
| MAG | L | L | L | H | H | H | H |
| EO | M | M | L | L | L | L | H |
| NEUTRON | L | L | H | H | M | L | L |
| ACOUSTIC | L | L | H | H | L | L | L |
| U/W ACOUS | H | M | L | L | L | H | L |
| U/W MAG | H | L | L | H | H | H | L |
| U/W EO | M | H | H | L | L | H | L |
| U/W CHEM | M | L | H | H | L | H | L |
| COTTON LINE | L | L | L | | | | |
| ACOUSTIC NAV | L | L | L | | | | |
| DGPS | H | M | M | | | | |
| MAG & FLAG | H | M | L | | | | |
| HYBRID | H | M | L | | | | |
| MAPPING | H | M | L | | | | |

SENSOR TECHNOLOGIES

- OTHER APPLICATIONS
 - ARCHEOLOGICAL SURVEY (GPR, EO)
 - NATURAL RESOURCES SURVEY (EO)

OBSERVATIONS

- NO SILVER BULLETS
- DETECTION QUESTION FOCUSES ON PROCESS NOT SENSORS
- CLASSIFICATION IS NEAR TERM
- IDENTIFICATION SENSORS NEAR TERM
- MAG & FLAG/HYBRID/MAPPING BASED ON TERRAIN, QUALITY CONTROL AND ABILITY TO REDUCE FAR
- UNDERWATER TECHNOLOGIES AVAILABLE